GOVERNMENT OF PUNJAB

TECHNICAL EDUCATION & VOCATIONAL TRAINING AUTHORITY

CURRICULUM FOR

CNC MACHINE OPERATOR

(3 – Months Course)

Revised April 2016

APPROVED
Date: 7- 4- 16
Sign:

CURRICULUM SECTION
ACADEMICS DEPARTMENT
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TRAINING OBJECTIVES

Pakistan is the developing nation and endeavoring to convert its economy from agriculture base to industrial base. In doing so it is installing such machinery & equipment in its industry, which has a fairly high degree of automation and demands engineering precisions.

In its industry, it has a good population of CNC machines installed for execution of precision engineering works.

This course aims at producing such skilled manpower, which can proficiently carryout work using CAD software, and subsequently use it for production through CNC machines.

CURRICULUM SALIENTS

Entry Level:	Matric with Science + Computer Skill
Total Duration of Course:	3 Month
Total Training Hours:	400 Contact Hours
Training Methodology:	80 % Practical
	20 % Theory
Medium of Instruction:	Urdu / English

SKILL COMPETENCY DETAIL

After the completion of this course the student will learn the following skills:

1. Draw pictorial drawings, orthographic drawings, Cylindrical and Pictorial drawings.
2. Use measuring & hand tools accurately & safely.
3. Apply safety procedure and observe work ethics on shop floor and work sites
4. Differentiate between CAD & CAM Software according to their applications / implementations
5. CNC Programming by Generating NC Code Files and alteration of 'G' & 'M' Codes
6. Properly setup the CNC machines using the CNC control panel and preparing the machines for executing work/ jobs
7. Make CNC lathe Machine job by performing
8. Operating Control Panel/Setting Parameters
9. Turning/Facing
10. Taper Turning/ Step Turning
11. Centre Drilling/ Boring
12. Internal and External Threading
13. To operate CNC lathe confidently.

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KNOWLEDGE PROFICIENCY DETAIL

After the completion of the course the student will have knowledge of:

1. Basic Mathematics to take the reading with the help of measuring tools.

2. Name and identification of measuring and Hand tools (Try square. Inside / Outside Caliper, Letter and Number Drills, Cutting Tools, Divider, Bench Vice, Thickness Gauge, Hammer, Steel Rule, Scriber, Center Punch, Chisels, Screw Pitch Gauge V-block, Micrometer, Inside Micrometer Venire Caliper, Bevel Protector, Dial Indicator, Height Gauge etc)

3. CNC machine (safety precautions, specification of CNC machine, their function and accessories of CNC).

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SCHEME OF STUDIES

CNC Machine Operator

(3 - Months Course)

S. No	Main topics	Theory Hours	Practical Hours	Total Hours
1.	Basic Drawing of Auto CAD	10	40	50
2.	Basic Mathematics	8	30	38
3.	Basic Machine Shop	20	80	100
4.	CNC Lath/Turning Machine Operation and Functions	30	122	152
5.	I.T Fundamentals	4	16	20
6.	Functional English	15	25	40
Total		**87**	**313**	**400**

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DETAIL OF COURSE CONTENTS

CNC Machine Operator
(3- Months Course)

S. No.	Detail of Contents	Theory Hours	Practical Hours
1.	**Draw of Line using Absolute, Relative ,Polar Methods**		-
	1.1. Basic Drawing with Auto CAD	1	
	1.2. File: New, Open, Save, Save As, Printer Set,	1	-
	Printer Preview And Print		-
	1.3. Edit: Undo, Redo, Cut And Copy.	1	
	1.4. View: Zoom Pan, Aerial View, Model Space,		-
	Paper Space, Hide Shade And Render.	1	
	1.5. Format: Layer Colour, Text Style Unit,		-
	Thickness, Drawing And Limits	1	
	1.6. Draw: Line Ray, Construction Line, Multi Line,		
	Poly Line Polygon, Rectangle, Arc, Circle,	1	
	Ellipse, Block, Hatch, Region, Text Surface		-
	And Solids.	1	
	1.7. Tool: UCS, Inquiry, Object Snap Setting And		-
	Drawing Aids		
	1.8. Dimension: Line, Aligned, Ordinate, Radius,	1	
	Diameter, Angular, Baseline, Continue,	2	-
	Oblique, Aligned Text And Style.		-
	1.9. Insert: Block.		
	1.10. Modify: Erase, Copy, Mirror, Offset, Array,		
	Move Rotate, Scale, Stretch, Trim Extent,		
	Brake, Chamfer, Fillet and Explode.		8
	Practical:-		
	1.11. Installation of CAD Software and Practicing of		**8**
	Draw, Edit, Format Modify, etc toolbars for		8
	different features.		8

	1.12. Draw Square, Triangle, Rectangle, Polygon 1.13. Draw Arc, Semi- Circle, Solid Shaft, Hollow Shaft. 1.14. Practice of single line and multi line Text in Given Drawing and using layers feature 1.15. Uses of Dimension Tool bar in Practical Drawings and practice of save and print		8
2.	**Basic Mathematics**		
	2.1. **Addition Of Fractions/Decimals**	1/2	
	2.2. Subtraction Of Fractions/Decimals	**1/2**	
	2.3. Multiplication Of Fraction/Decimals	1	
	2.4. Division Of Fraction/Decimals	1	
	2.5. Calculation of Circumference, R.P.M ,Feed	2	
	Rate, Speed, etc.	1	
	2.6. Tolerances of Fractions/Decimals	2	
	2.7. **Trigonometric Ratios**		4
	Practical:-		4
	2.8. Exercise of mathematical ratios		2
	2.9. Exercise of addition of faction /Decimals		2
	2.10. Exercise of subtraction of faction /Decimals		
	2.11. Exercise of multiplication of faction /Decimals		4
	2.12. Exercise of division of faction /Decimals		6
	2.13. Exercise of Circumference, R.P.M ,Feed Rate,		2
	Speed, etc.		6
	2.14. Exercise of tolerances		
	2.15. Exercise of trigonometric ratios.		

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3.	**Basic Machine Shop**		
	3.1 Measurement and Measuring Tools.		
	3.1.1 Importance of Measurement &define Matric		
	and English System and Their Units.	1	
	3.1.2 Conversation of Millimeter to inch and other	2	
	units.	2	
	3.1.3 Introduction of measuring Tools and their		
	uses and least count method		20
	Practical:		
	Practice of Measurement with different measuring		
	tools (Vernier Caliper, Micrometer, thread gauge,		
	Radius Gauge bevel protector, Dial indicator etc)		
	Off hand grinding		
	3.1.4 Safety precautions (Personal &		
	Machine)	1	
	3.1.5 Angle of turning tools (left hand & right	1	
	hand, roughing & side cutting)	1	
	3.1.6 Angle of parting tool	1	
	3.1.7 Angle of centre drill.		02
	Practical:-		
	3.1.8 Grinding of Left hand roughing of tool.		02
	3..1.9Grinding of Right hand side cutting of tool.		02
	3.1.10Grinding of Parting off tool.		02
	3.1.12Grinding of Centre Drill		
	3.2 .**Introduction & Basic Functions.**	1	
	3.2.1 Introduction of Manual/CNC Lathe & Safety	1	
	in Operating	1	
		1	
	3.2.2 Introduction to CNC tools	1	
	3.2.3 Introduction to CNC Lathe Axises /reference	2	
	position.		

	3.2.4 Techniques of Straightening of job	4	
	3.2.5 Defining Manual, NC & CNC System		6
	3.2.6 Studying& operating of control panels (Fanuac/Siemens)		6
	3.2.7 Introduction to Preparatory & Miscellaneous Functions (G Codes, M Codes)		5 6
	Practical:-		7
	3.2.8 Demonstration of CNC lathe /parts and their working and applying safety precaution		8 2 6 6
	3.2.9 Types of CNC tool /Inserts and application (right hand, left hand. cutting, grooving etc.)		
	3.2.10 Demonstration of reference position and Axises		
	3.2.11 Straightening of job with Chuck and Keys		
	3.2.12 Practice of operating Control panel /different operating keys		
	3.2.13 Function of different G and M Codes (Practice)		
	3.2.14 Job Referencing & Tool Offsetting		
	3.2.15 Simple Turning Exercise		
	3.2.16 Simple Step turning practice		
4	**CNC Turning/Lath Machine Operation /programming**	2	
	4.1 Part Programming/Machine Cycle	2	
	4.2. Incremental /absolute Co-ordinate calculations techniques	2	
	4.3. Linear interpolation	2	
	4.4. Incremental/Absolute co-ordinate programming	2 2	
	4.5. Operating in MDI/AUTO Mod	2	
	4.6. Turning and facing	2	

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	4.7. Circular interpolation & rough cuts	2	
	4.8. Canned cycle facing & roughing	2	
	4.9. Canned cycle grooving	2	
	4.10. Canned cycle for threads	2	
	4.11. Tool-wise Allocation in Tool Post	2	
	4.12. Canned cycle for peak drilling	2	
	4.13. Circular interpolation partial axis	2	
	4.14. **Drilling, Boring & Tapping**		
	4.15. Basic of machine maintenance		8
	PRACTICAL		5
	4.16. Study of CNC & Control panel MDI/Auto mode		
	4.17. Study of Communication b/w Control Panel &		5
	Part Programming File		8
	4.18. To calculate co-ordinates for given sketches		5
	4.19. Study & application of linear interpolation		5
	4.20. Incremental and Absolute co-ordinate		10
	programming		12
	4.21. Exercise (turning, facing)		12
	4.22. Tool-wise Allocation in Tool Post		12
	4.23. Circular interpolation exercise		12
	4.24. Canned cycle facing and roughing exercise		12
	4.25. Canned cycle grooving exercise		10
	4.26. Canned cycle threading exercise		02
	4.27. Canned cycle drilling exercise		4
	4.28. Circular interpolation partial axis exercise		
	4.29. Tool of setting techniques exercise		
	4.30. Basic repairs & maintenance exercise		
	Total	**68**	**272**

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LIST OF PRACTICALS

A	Basic Auto CAD
1	Installation of Auto CAD Software & uses of different tools bars
2	Draw Square, Triangle, Rectangle, Polygon
3	Draw Arc, Semi- Circle, Solid Shaft, Hollow Shaft.
4	Practice of single line and multi line Text in Given Drawing
5	**Practice of dimension tool bar and save Print in the given drawing**
6	**Basic Mathematics** Exercise of mathematical ratios Exercise of addition of faction /Decimals Exercise of subtraction of faction /Decimals Exercise of multiplication of faction /Decimals Exercise of division of faction /Decimals Exercise of tolerances Exercise of trigonometric ratios.

B	Basic Machine Shop
1.	Practice of Measurement with different measuring tools like Vernire Caliper, Micrometer, Thread gauge, Radius Gauge bevel protector etc)
2.	Grinding of Left hand roughing of tool. Grinding of Right hand side cutting of tool. Grinding of Parting off tool. Grinding of Centre Drill
3.	Demonstration of CNC lathe /parts and heir working and applying safety precaution
4.	CNC tool / Types of Inserts and application (right hand, left hand. cutting, grooving etc.)
5.	Demonstration of reference position and Axis's
6.	Straightening of job with Chuck and Keys
7.	Practice of operating Control panel different operating keys
8.	Function of different G and M Codes (Practice)
9.	Job Referencing & Tool Offsetting
10.	Simple Turning Exercise
11.	Simple Step turning practice

C	A-2 CNC Lathe/Turning operation/Programming
1	Starting of Work with Safety & Cleanliness
2	Applying Safety Precautions & Safety Measures
3	Use of Emergency Switch & Its Necessity
4	Brief Introduction to the CNC Control Panel & Its Operating
5	Step-by-Step Operating Methods
6	Operating in Idle Mode

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7	Operating in MDI Mode
8	Operating in Auto Mode
9	Communication b/w Control Panel & Part Programming File
10	Pre-Inspection Before Starting the Work
11	Usage of Straight Turning Features
12	Usage of Rough Turning Features
13	Usage of Finish Turning Features
14	Usage of Rough Profile Features
15	Usage of Grooving & Parting-Off Features
16	Work Part Referencing Procedure
17	Tool-wise Allocation in Tool Post
18	Part Programming Execution Procedure
19	Dealing with Emergency Situations
20	How to Edit the Part Programming File in Safe Manners
21	Resetting & Resume Machining Cycle after Interruptions
22	Working on Various Practical Jobs as per Instructor's Direction
23	Performing job as by given drawing by instructor

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SCHEME OF STUDIES

I.T Fundamentals

S.No	Main Topics	Theory Hours	Practical Hours	Total Hours
1.	Introduction to Computers	1	4	5
2.	Typing - Microsoft Word	2	6	8
3.	Internet & Electronic Mail	1	6	7
Total		**04**	**16**	**20**

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Prepared by Curriculum Section, Curriculum Department, TEVTA

19.	Center drill	05
20.	HSS tool bit	01
21.	Oil cane	05
22.	Center gauge	02
23.	Center punch	05
24.	Vernier caliper	05
25.	Adjustable wrench 12”	05
26.	Flat file	05
27.	Micro meter (mm)	05
28.	Micro meter (inch)	05
29.	Dial indictor	01
30.	Adjustable wrench 6”	05
31.	Safety goggles	05
32.	Combination pliers	05
33.	Tool box	05
34.	Computer Training Station for CNC (with software)	05
35.	CNC Machine	02

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COMPUTER LAB

S. No.	Tools / Equipment	Quantity
1.	Desktop computer (Specifications as per notification issued by MIS Section, TEVTA)	26 (1 for each student & 1 for the teacher)
2.	Printer (Laser)	01
3.	Scanner	01
4.	Internet Connection (At least 1 MB speed)	01
5.	UPS 10 KVA	01
6.	Air Conditioner 1 ½ Ton	02
7.	Multimedia Projector	01

CONSUMABLE MATERIALS

CNC Machine Operator

S. No.	MATERIAL	Piece	For 25 Trainee
1.	MS Rod Ø 25x100mm	one	25
2.	MS Rod Ø 15x100mm	one	25
3.	MS Rod Ø 30x100mm	one	25
4.	MS Rod Ø 20x100mm	one	25
5.	Aluminum Rod Ø 25x100mm	one	25
6.	Aluminum Rod Ø 25x100mm	one	25
7.	Aluminum Rod Ø 25x100mm	one	25
8.	Aluminum Rod Ø 25x100mm	one	25
9.	Stain less Steel Rod Ø 25x100mm	one	25
10.	Aluminum Rod Ø 25x100mm	one	25
11.	Aluminum Rod Ø 35x100mm	one	25
12.	Brass Rod Ø 25x100mm	one	25
13.	M.S Rod Ø 55x100mm	one	25
14.	Aluminum Rod Ø 10x100mm	one	25
15.	Brass Rod Ø 45x100mm	one	25
16.	Tungsten Carbide Inserts (for left hand tool)	2	50
17.	Tungsten Carbide Inserts (for right hand tool)	2	50
18.	Tungsten Carbide Inserts (for parting tools hand tool)	5	250
19.	Tungsten Carbide Inserts (for grooving tool)	2	50

20.	Tungsten Carbide Inserts (for threading tool)	2	50
21.	Tungsten Carbide Inserts (for left hand tool)	2	50
22.	Tungsten Carbide Inserts (for facing and turning tool)	2	50
23.	High speed tools different shapes	1	25
24.	H.S.S Drills	2	50
25.	H.S.S. Tapes	3	75
26.	Lubrication oil	litre	25
27.	Cutting Oils	litre	100

Functional English

S. No.	Item	Quantity
1.	Stationery	As per requirement
2.	Board Markers	As per requirement

I.T Fundamentals

S. No.	Item	Quantity
1.	Printing Paper	As per requirement
2.	Printer Toner	As per requirement

REFERENCE BOOKS

CNC Machine Operator

1 Technology of Machine Tools By S.F Karar & A.F Check

2 McGraw Hill (Mechanical Engineering Series)

3 CNC Machining Handbook (by James Madison, Publisher: Industrial Press, Inc.;

4 1st edition (January 1, 1996)

5 CNC Programming Handbook (by Peter Smid Publisher: Industrial Press, Inc. 3rd Edition (November 26, 2007)

6 Applied CNC Machining (Paper Back) by Josh Mitchell.

Functional English

1. High School English Grammar By Wren & Martin
2. Oxford English Grammar

I.T Fundamentals

1. Introduction to Computer by Peter Norton
2. 2007 Microsoft® Office System Step by Step by Joyce Cox, Steve Lambert and Curtis Frye
3. Internet and E-mail with Windows 7 by Studio Visual Steps

EMPLOYABILITY OF PASS-OUT

The pass outs of this course may find job / employment opportunities in the following sectors / areas: -

1. POF (WAH)
2. NDC
3. HMC
4. SMC
5. SPELL (LTD, Aeronautical complex (Kamra)
6. Shipyard
7. Atomic Energy
8. KRL
9. Automobile Industry.

MINIMUM QUALIFICATION OF INSTRUCTOR

CNC Machine Operator

- B.Sc. Mechanical Engineering with 2 year relevant experience.

OR

- DAE in Mechanical Technology with 5 years relevant experience.

Functional English

- M.A (English)

I.T Fundamentals

- DAE CIT/ BCS from HEC recognized university

LIST OF TRADE RELATED JARGON

CNC	Computer Numerical Control	Z-Axis	Length Controlling Axis
NC	Numerical Control	X-Axis	Diameter Controlling axis
DNC	Direct Numerical Control	Measurement	پیمائش
Components	حصے	Multiplication	ضرب
Auto CAD	Automatic Computer Aided Designing (Software by Auto Desk)	G codes	Control the Tool Motion
ATC	Automatic Tool Changer	M Codes	Control the Machine/tool Function
RPM	Revolution Per Minute	CAM	Computer aided Manufacturing
C.S.	Cutting Speed(m/min)	ISO	International Standard Organization
Cutting	کاٹنا	WCS	Word Co-Ordinate System
Decimal	اعشاریہ	c.m	Centimeter
Diagram	شکل	ø	Show Diameter
Energy	توانائی	Micro Meter	1/1000000 th of Meter
Equipment	آلات	Structure	ساخت
Faults	نقائص	Tools	اوزار
Files	ریتی	Tracing	تلاش کرنا
Absolute Positioning System	Position from Origin (Zero/ fix point)	Tri square	گنیا
Incremental Positioning System	Position from current point	Understanding	سمجھنا
MDI	Manual Data input	Vernier Caliper	ورنیر کیلیپر
AUTO	Automatic	Thread Gauge	Use for Thread Pitch Calculation
Fanuc	Operating Panel By Japans	M.S.	Mild Steel
Siemens	Operating Panel By Korea	H.S.S	High speed Steel
Trigonometry	Mathematics branch for Triangle Ratios	m.m	Mille meter
UCS	User Co-ordinates System	CIM	Computer integrated Manufacturing
Installation	لگانا	Tungsten Carbide	Type of Hard Cutting Material/Tool

Curriculum Revision Committee

1.	**Muhammad Farooq,** Sr. Instructor, GSPCT	**Convener**
2.	**Engr. Munir Ahmad,** Sr. Instructor, LESC Gujranwala	**Member**

DETAIL OF COURSE CONTENTS

I.T Fundamentals

S. No	Detail of Topics	Theory Hours	Practical Hours
1	**Introduction to Computers** 1.1 What is a computer- Definition, functions and general features? 1.2 What is Hardware – 1.2.1 Computer parts and units 1.2.1.1 Input Unit - Keyboard, Mouse etc. 1.2.1.2 Central Processing Unit 1.2.1.3 Output Unit 1.3 What is Software – 1.3.1 Electronic Parts of a Pc it is 1.3.1.1 Software and Its types 1.3.1.2 System Software, Application Software 1.4 Working with windows Operating System 1.4.1 How does windows desktops work? 1.5 What are the Icons, Shortcuts and other graphic, 1.5.1 How to see computer contents on different drives etc	1	4
2	**Typing and Word processing (MS Word)** 2.1 Proper way of typing correct and speedy - getting familiar with the keys 2.2 Where to type in computer? How to save a file? How to get it back? Where to find your saved work? 2.3 How to get it printed?	2	6
3	**Emailing and Internet Surfing** 3.1 How to go to Internet, what is required for an	1	6

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	internet connection etc. 3.2 How to use email? How to search on web? Etc 3.3 How to make new email account, login and logout an email account etc.?		
Total		**04**	**16**

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LIST OF PRACTICALS

I.T Fundamentals

S. No.	Name of Practical
1.	Turn On/Off and setting of power supply
2.	Accessing The Desktop
3.	Using of Icons and Shortcuts
4.	Setting / customizing the desktop
5.	Viewing the contents of computer – Directory
6.	Copying, Deleting and Moving Files in a folder
7.	Working with different Applications
8.	Opening MS Word for typing
9.	First lesson of Typing A S D F
10.	Second Lesson of typing J K L ;
11.	Third Lesson U I O P
12.	Fourth Lesson R E W Q
13.	Fifth Lesson N M , .
14.	Sixth Lesson V C X Z
15.	Seventh Lesson All letter using R index Finger
16.	Eighth Lesson All letter using L index Finger
17.	Formatting in MS Word Bold, Italic etc.
18.	Using Internet
19.	Opening Email, making new account
20.	Sending Receiving Emails

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SCHEME OF STUDIES
Functional English

S.No	Main Topics	Theory Hours	Practical Hours	Total Hours
1.	Introduction of English Sentence Structure	2	3	5
2.	Use of present indefinite tense	2	3	5
3.	Use of 'is' 'are' 'am' questions and negatives	2	3	5
4.	Ask questions	2	3	5
5.	Express daily routines	2	3	5
6.	Know how to address people	1	2	3
7.	Provide written feedback	1	2	3
8.	Dialogues	1	2	3
9.	Understand vocabulary	1	2	3
10.	Application/C.V.	1	2	3
Total		**15**	**25**	**40**

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DETAIL OF COURSE CONTENTS

Functional English

S. No	Detail of Topics	Theory Hours	Practical Hours
1	**Introduction of English sentence structure**	2	3
2	**Use of present indefinite tense with exercises**	2	3
3	**Use of 'is' 'are' 'am' questions and negatives**	2	3
4	**4.1 Ask questions** 4.1.1 At work place 4.1.2 In the market 4.1.3 In classroom	2	3
5	**5.1 Express daily routines** 5.1.1 Before going to college 5.1.2 Dealing with colleagues 5.1.3 Going to market	2	3
6	**6.1 Know how to address people** 6.1.1 In Meetings **6.1.2** In class	1	2
7	**7.1 Provide written feedback** 7.1.1 After visiting the market 7.1.2 On some official task	1	2
8	**8.1 Dialogues** 8.1.1 With colleague 8.1.2 Teacher/student 8.1.3 Employer/employee 8.1.4 Booking on railway station	1	2
9	**Understand vocabulary**	1	2
10	**Application / C.V.**	1	2
	Total	**15**	**25**

LIST OF PRACTICALS
Functional English

S. No.	Practical
1.	Group discussion
2.	Interviews
3.	Role play

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LIST OF LABS

CNC Machine Operator

- CNC Lab

I.T Fundamentals

- Computer Lab

LIST OF TOOLS & EQUIPMENT'S

(For a Class of 25 Students)

Name of trade	CNC Machine Operator
Duration of course	3-Months

S. No.	Nomenclature of Equipments /Tools	Quantity
1.	CNC Machine	02
2.	Latest Computer (As per TEVTA MIS Notification)	06
3.	Printer	02
4.	CNC machine tooling (different inserts and drills)	05 each
5.	Screw rule	10
6.	Screw driver set	05
7.	Philip screw driver set	01
8.	Taps and tap handle	10
9.	Screw pitch gauge	10
10.	Radius gauge	05
11.	Combination set	02
12.	Allen key set	02
13.	Double and open hammer	02
14.	Number punch set	05
15.	File brush set	01
16.	Letter punch set	01
17.	Needle file set	02
18.	File brush	05